gage and other painted instruments of the Weather Bureau equipment had the paint sand-blasted from them, as did some houses about town. The rain gage on the Weather Bureau grounds registered 0.15 inch of sand.

Figure 1 gives an idea of the velocity of the pebbles that were carried by the wind. The window is riddled

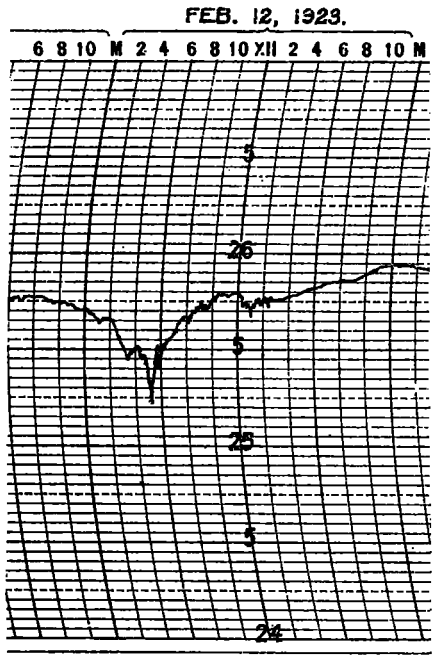

FIG. 3.—Barograph trace at time of windstorm at Independence, Calif., Feb. 12, 1923.

as if a machine gun had been turned on to it. The pebbles passed through without cracking the panes to the edge. Figure 2 shows a ranch house at Fort Independence after the storm.

The loss of the roof of the courthouse is explained as the result of internal pressure. No doubt if the windows had not blown in the roof would have held intact. All windows in this building were heavy plate glass. It was the foreign objects in the wind that broke the windows and not the force of the wind. The writer experienced a 110-mile hurricane, with air free of débris, at Tatoosh Island, Wash., during which no windows in the Weather Bureau building were broken. The storm at Independence blowing 80 miles an hour carried a blast of sand and pebbles through all of the windows in the Weather Bureau office facing the wind.

During the blow the sky was clear over the area of destruction, but a thick, heavy bank of stratus clouds hung over the eastern side of the valley, where but little effect of the wind is seen. During the evening of the 11th low temperature prevailed, but on the morning of the 12th the temperature increased with the wind. During the maximum phase of the storm the barograph trace for Independence shows (Fig. 3) a fall of half inch during the three hours preceding the highest wind. A fall of twenty-five hundredths inch took place during the 30-minute period preceding the peak of the storm. Light winds occurred at all the surrounding stations, except at Reno, Nev., about 200 miles to the northward. These facts lead to the conclusion that the influence of the storm was felt to the westward and northward only.

During the warm months the prevailing direction of the wind is up the valley, and in the other months it is down the valley. During the winter months moderately high winds from the northwest frequently occur. These winds, whether up or down the valley, are regular winds. Winds from the northeast or east seldom occur. The northwest winds are cold and dry and bring clear weather, and often continue at a rate from 25 to 50 miles an hour for several days at a time, but rarely reach destructive velocities. The destructive winds come from the west or southwest down from the mountains.

Since 1914 wind velocities of 60 miles an hour, or more, have occurred at this station six times.

Previous to this storm Owens River Valley has suffered but little from windstorms.

PREDICTING MINIMUM TEMPERATURES.

By WALTER J. BENNETT, Meteorologist.

[Weather Bureau Office, Tampa, Fla., February 19, 1923.]

The relation between relative humidity and dew point at the p. m. observation and the minimum temperature the next morning has been shown by Prof. J. Warren Smith and others to be a very real one. (Supplement 16, MONTHLY WEATHER REVIEW.) Also it has been shown that for some localities the mean solar noon observation may be used with great accuracy, and thus give a determination of the minimum temperature early enough in the day to be of practical benefit. (E. M. Keyser, MONTHLY WEATHER REVIEW, October, 1922.)

But it would be a mistake to put too much faith in the relative humidity and dew point observations, especially in cases when a drop in temperature is to be expected not from radiation alone, but from the bodily movement of a large mass of cold air. Such cases are of great importance in Florida.

A tolerably exact forecast of the minimum temperature is a real necessity for this section of the country.

A study of past records shows that when the temperatures mentioned in the next following paragraph are reached the results as indicated will follow. The temperatures are those recorded in the Weather Bureau thermometer shelter exposed on the roof of the post-office building in Tampa. Ground and grove temperatures will run from 2° to 10° lower within a few miles, depending upon local conditions.

A temperature of 40° to 42° indicates light frost with little damage; 38° to 40° means considerable damage to tender vegetables; 36° to 38° much greater damage; 34° to 36° a damage of 50 per cent or more to vegetables; 32° to 34°, almost complete destruction of vegetables, except when protected or in specially favored localities; 30° to 32° kills vegetables and damages the young growth on citrus trees; 28° to 30° will kill young trees unbanked; 26° to 28° will freeze some oranges, kill young trees and seriously damage young growth; 24° to 26° will freeze many oranges and damage trees; 22° to 24° means practically all oranges frozen and many trees frozen to the ground. Below 22° means extremely great damage to all groves not protected by heaters.

To determine how valuable the indications of the noon relative humidity and dew point would be in determining the minimum temperatures, dot charts were made for the several months of December, January, February, and March covering five years past, and curves were drawn free hand. Separate charts were first made for clear,

partly cloudy, and cloudy weather, but there was so little difference in shape and location of the several curves, that all observations were used for each month, regardless of the state of the sky.

The records of the office were then searched for all predicted minimum temperature during the past five years. Minima are predicted only when frost or near-frost temperatures are expected, and such predictions are seldom made on Sundays, because few or no reports are received Sunday mornings. In all, there were found 57 cases in which a definite prediction of the minimum temperature was made. The error between this predicted temperature and the actual minimum was then taken for each case. The relative humidity and the dew point at the noon observation were then consulted and the departure of the temperature indicated by the curve from the actual minimum was taken for each case.

The actually predicted minimum was within 4° of the real minimum 36 of 57 times, or 63 per cent. The minimum indicated by the dew-point humidity curve showed exactly the same percentage of accuracy. This was for the 57 special cases only, when the degree of cold was of real importance. If minimum temperatures were predicted by the curve every day, the average percentage of accuracy would be considerably greater.

The average error, taken regardless of sign, of the temperature forecast from the a. m. weather map was 4.1. The average error of the temperature indicated by the dew-point humidity curves was 4.3, nearly the same. Considering plus and minus departures, it was found that the minimum temperature was below the curve-indicated temperature 27 times, with an average minus departure of 4.4. It was above 24 times, and exactly equal 6 times. Incidentally, this almost equal distribution of plus and minus departures furnishes a fair check on the accuracy with which the curves were drawn.

Taking the temperatures actually forecast from the weather map, it was found that the real minimum went lower than the predicted minimum only 14 times out of the 57, and the average minus departure was only 1.9°. This was undoubtedly due to a conscious intention on the part of the forecaster to predict a temperature just a little lower than he actually expected.

Going back now to the last serious freeze experienced in this locality, we find that the temperature forecast for Tampa on the morning of February 2, 1917, for the morning of February 3 was 25°, and the actual minimum was 26°. This was before the mean solar noon observations were begun, but computations from corrected hygrograph readings applied to the curve, show that the minimum indicated by the curve would have been 33°. Estimating the minimum temperature in this case 7° too high would have been a calamity.

It would seem that for this particular locality, when the minimum temperature is of real importance and not merely of scientific interest, it may be estimated from the 8 a. m. weather map more accurately than it can be indicated by dew-point humidity curves from observations at noon. But these noon readings may be useful in checking or confirming the minimum forecast, and it may be possible to develop a correction curve based upon the barometric gradient that would be of practical value.

NOTES, ABSTRACTS, AND REVIEWS.

Paul Frederick Maxwell (1892-1923).

Paul Frederick Maxwell, in the strength and vigor of early manhood was overwhelmed by a snowslide on one of the steep slopes of the denuded area of the Wagon Wheel Gap, Colo. Experiment Station on March 5, 1923. When his body was found 5 hours later life was extinct. Mr. Maxwell left camp about 9 a. m. to make the regularly scheduled snow depth and density measurements on the denuded watershed. Not returning at the expected time his companions at the camp, Messrs. Weld and Torrence immediately set out in search of him. On arriving at the B-area they saw that a snowslide had occurred on what is known as "Snowstake area B-11;" and when they found snowshoe tracks leading to the slide their worst fears were realized. An hour's search failed to reveal the body, but finally the heel of a snowshoe was discovered projecting from a snow bank at the bottom of the slide, and the body was soon uncovered. Slowly and with difficulty the body was borne back to the camp, arriving there at 7:30 p. m., a little less than 12 hours from the time of his departure in the morning.

Mr. Maxwell entered the service of the Weather Bureau in 1916, and had seen service at North Head, Wash.; Boston, Mass.; and New Haven, Conn. From the last-named station he was transferred to Wagon Wheel Gap and was in his second year of duty at that station.

Snowslides have occurred in both watersheds at the Wagon Wheel Gap project while yet in timber due to the very great angle of the slopes, 35° in places. With the removal of the timber from the B-area the hazard of slides greatly increased and this fact was fully realized by the observers, who, nevertheless, with a fidelity that is extremely gratifying, carried on under these circumstances.

It was the writer's privilege to have known Mr. Maxwell personally and to have discussed with him the observational material of the project. His mind was keenly alive to the problems involved and he gave his best efforts toward their solution.

His memory will be treasured by his associates in the Weather Bureau as one who made the supreme sacrifice, just as truly as did those who gave up their lives on the scarred battlefields of France and Belgium. Mr. Maxwell is survived by his parents, Mr. and Mrs. W. D. Maxwell, of Baker City, Oreg., and by his wife and three small children. To all of these, his associates in the Weather Bureau extend their deep and lasting sympathy in the loss sustained by this tragic event.—*A. J. H.*

WARMER AIR IN REAR OF CYCLONE OF FEBRUARY 8, 1923.

The morning weather map for the United States, February 8, shows a depression of the barometer accompanied by the usual cyclonic wind circulation centered over the Great Basin. Immediately in the rear of the cyclone center is the legend "Warmer 20 degrees." The orthodox temperature distribution in cyclones which visit the United States is warm in front and cold in the rear; it is well known, however, that this distribution does not hold for the Pacific coast and the northern Plateau regions. The present case is of sufficient interest to warrant a few words of explanation.

On February 7 an anticyclone, sea-level pressure, 30.40 inches, occupied the region in question, but, by the next morning, it had vanished and the identical region was occupied by a cyclone as above mentioned. The